

An Easy Non-GIS Method for Making 3-D Digital Terrain Illustrations Using USGS 1:24,000- and 1:250,000-Scale Digital Elevation Models and Bryce4 Software

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ABSTRACT

Three-dimensional (3-D) digital terrain illustrations offer the graphic designer and scientist an excellent way to portray certain geologic, geomorphic, tectonic, and topographic features for a range of scientific and popular publications. Making such illustrations has, until recent years, required the use of sophisticated GIS software, a steep learning curve, and much time and patience. A non-GIS software, Bryce4, used in conjunction with Adobe PhotoShop and Illustrator, provides graphic designers and scientists with an easy way to use USGS 1:24,000- and 1:250,000-scale Digital Elevation Models (DEM's) to make attractive 3-D terrain illustrations for use on the Web and in print and electronic publications. On this poster, we present the current status of non-GIS methods used in the Central Publications Group to produce 3-D terrain illustrations for use in USGS publications.

The poster presents a "cookbook" approach that includes all steps necessary to easily produce 3-D digital terrain illustrations. Toward that end, the poster reviews many of the steps discussed in Patterson (1998) and Sammis (1999). However, the poster presents additional information we think will be helpful to users, such as (1) how to maintain high resolution in 3-D terrain illustrations that will be used in print publications, (2) information on file formats and how to export 3-D images for further manipulation and corrections in Adobe PhotoShop and Illustrator, (3) information about tools in PhotoShop that are useful for manipulating colors and repairing imperfections in 3-D images exported from Bryce4, and (4) how to merge DEM's in Bryce4. Screen-optimized and print-optimized PDF's of the poster can be viewed and downloaded at URL http://cpg.cr.usgs.gov/. The authors thank Diane Wells and Gene Ellis for their helpful reviews.

Patterson, Tom, 1998, 3D landscape presentation-experiments at the U.S. National Park Service: Paper presented at the German Society of Cartography-Working Group of High Mountain Cartography, Bielerhöhe, Austria, February 26-March 1, 1998; also available on the World Wide Web at URL http://www.nps.gov/carto/silvretta/mtn.html (on the server of the North American Cartographic Information Society).

SOFTWARE FOR MAKING 3-D TERRAIN ILLUSTRATIONS

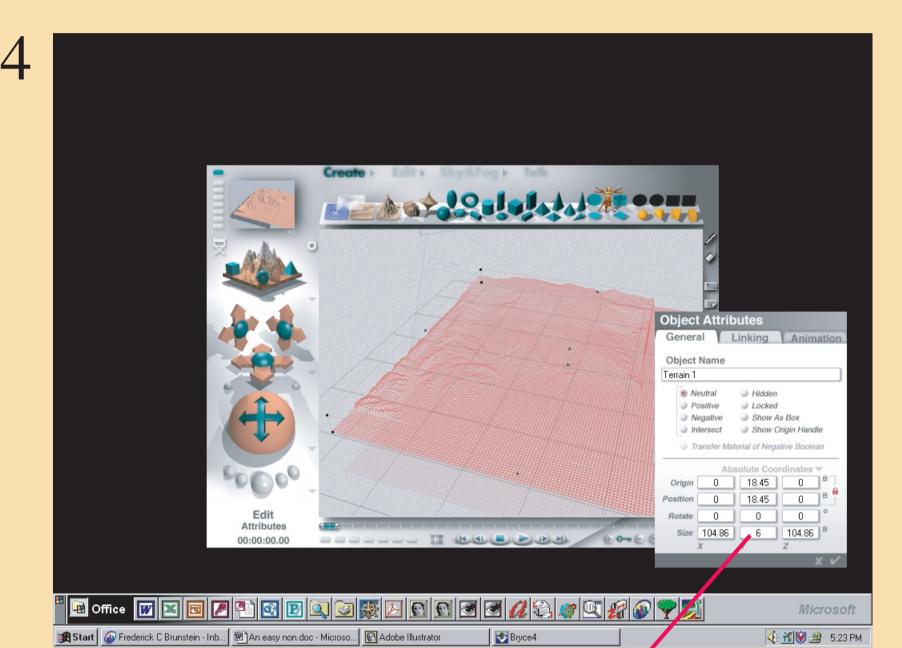
Sammis, Ian, 1999, How to make relief maps with Bryce: MacADDICT, v. 4, no. 12, p. 94-96.

Bryce4: (a PC- and Mac-compatible computer program by MetaCreations); for more information see URL http://www.metacreations.com.

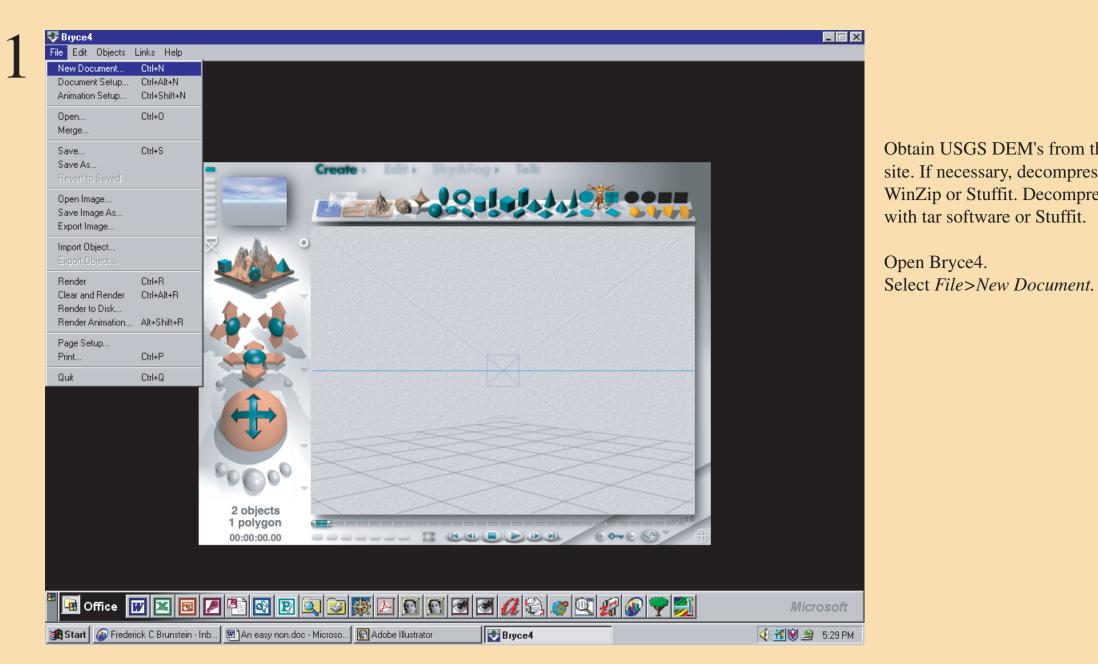
MICRODEM/TerraBase II 4.0: (a PC-compatible computer program written by Peter Guth of the Oceanography Department, U.S. Naval Academy); can be downloaded free of charge at URL http://www.usna.edu/Users/oceano/pguth/website/microdem.htm [Note: at the present time, this software has the ability to make, manipulate, and display 3-D terrain images, but no capability is provided in the software to export such images for use in other programs.]

MacDem Beta-0.7: [a Mac-compatible computer program written by Jerry Farm (<macdemweb@treeswallow.com>)]; can be downloaded free of charge at URL http://www.nacis.org/cp/cp28/resources.html [Note: at the present time, this software has the ability to make, manipulate, and display 3-D terrain images, but we are unsure of its capability to export such images for use in other programs.]

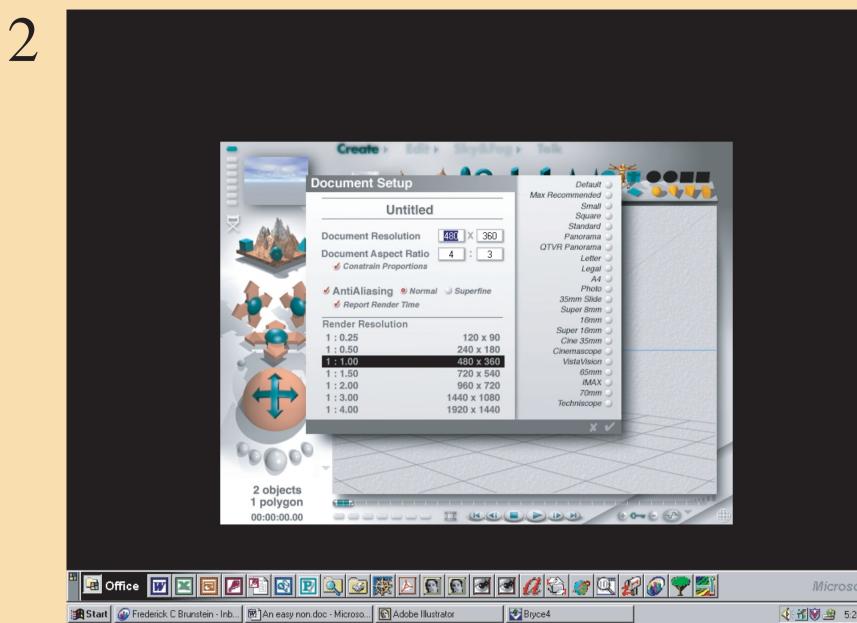
USGS WEB SITE FOR DOWNLOADING 1:24,000- AND 1:250,000-SCALE USGS DEM'S [USGS DEM's are not available for other scales, such as 1:100,000, 1:500,000, and 1:1,000,000.]



Increase this number to increase the vertical exaggeration so that topographic features show up better.



Obtain USGS DEM's from the USGS Web site. If necessary, decompress .gz files with WinZip or Stuffit. Decompress .tar files with tar software or Stuffit.



In the *Document Setup* window, select *Render* Resolution desired. Note that Bryce outputs 72 dpi files, which is fine for Web publications but is too low for print publications. However, resolution can be increased by increasing *Render Resolution* screen sizes, and then reducing and resampling the image at higher resolution in PhotoShop (see step 8). Larger screen sizes provide larger images composed of more pixels and provide sufficient resolution for print

publications when reduced and resampled at higher resolution in PhotoShop (see step 8). The following table shows screen sizes converted to image sizes in inches and the sizes needed to convert to when resampling at 300 dpi in PhotoShop in order to theoretically preserve maximum detail (see step 8). However, it is often easier to use larger resample sizes than recommended below, and still produce acceptable results when resampling at 300+ dpi

Render	Size of image	Resample s	
resolution	(inches)	at 300 dpi	
(pixels)			
120 x 90	1.6 x 1.25	0.4×0.3	
240 x180	3.3 x 2.5	0.8×0.6	
480 x 360	6.6 x 5	1.6 x 1.2	
720 x 540	10 x 7.5	2.3 x 1.8	
960 x 720	13.3 x 10	3.2×2.3	
1440 x 1080	20 x 15	4.8 x 3.6	
1920 x 1440	26 x 20	6.2 x 4.8	

the DEM and display wireframe image of the DEM.

Find your DEM file in the directory

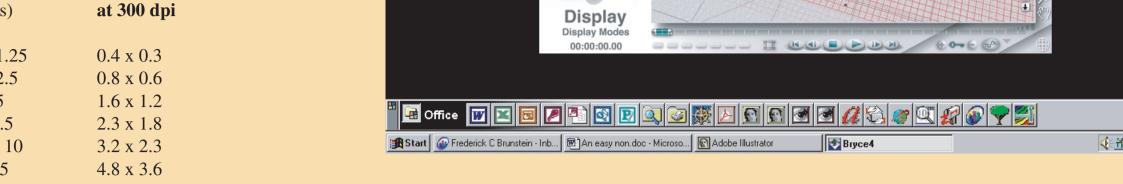
structure and click Open. Bryce will open

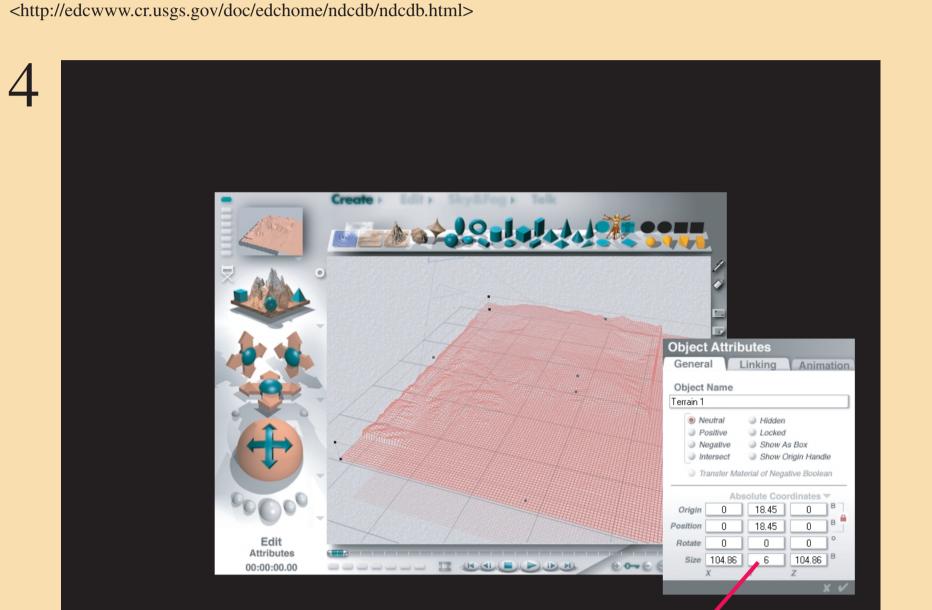
Select File>Import Object

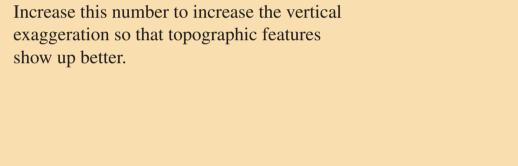
Click on the wireframe icon to increase the density of wireframe, if desired.

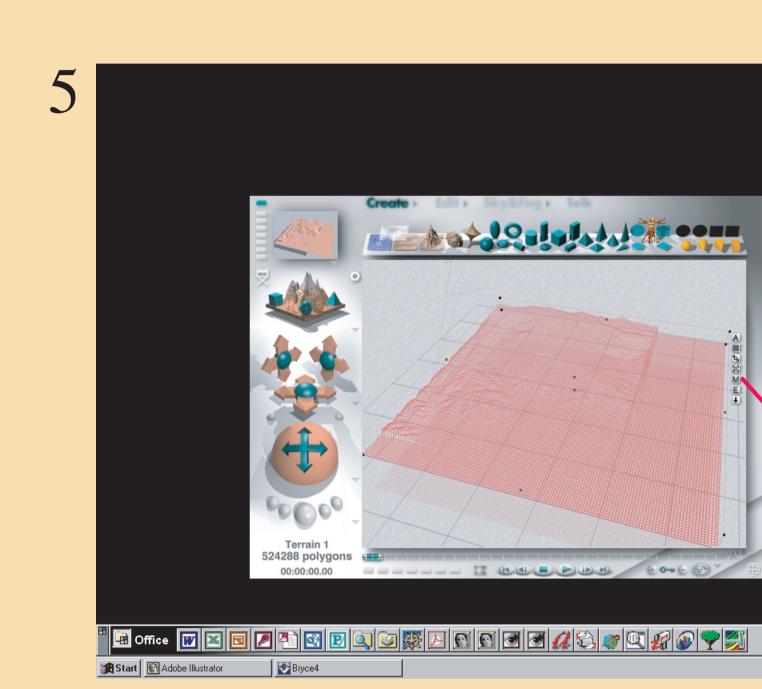
Higher numbers show more detail.

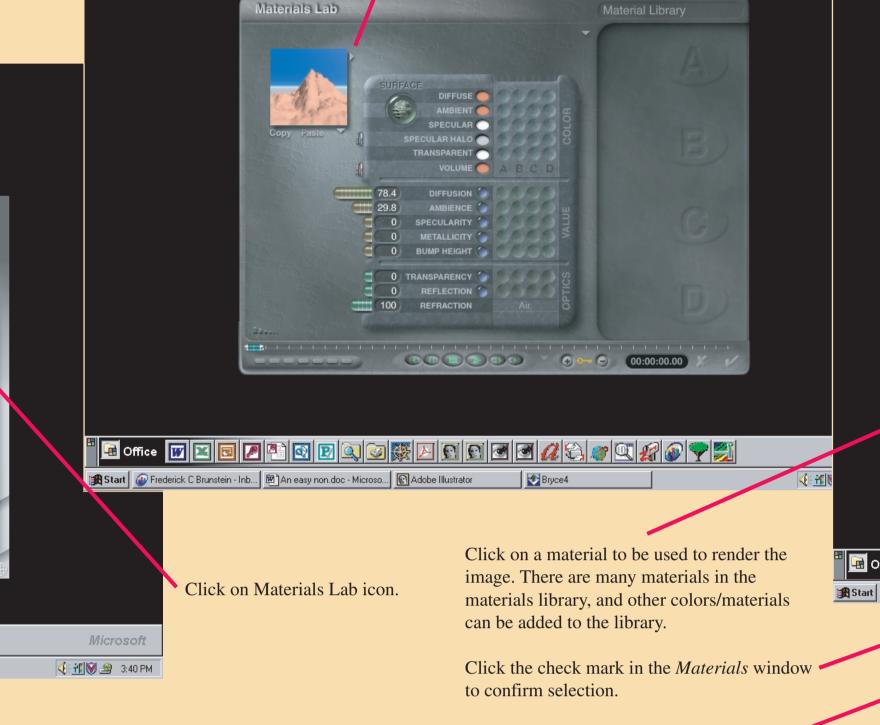
Click on the Attributes button. Dialog box will appear (next panel).







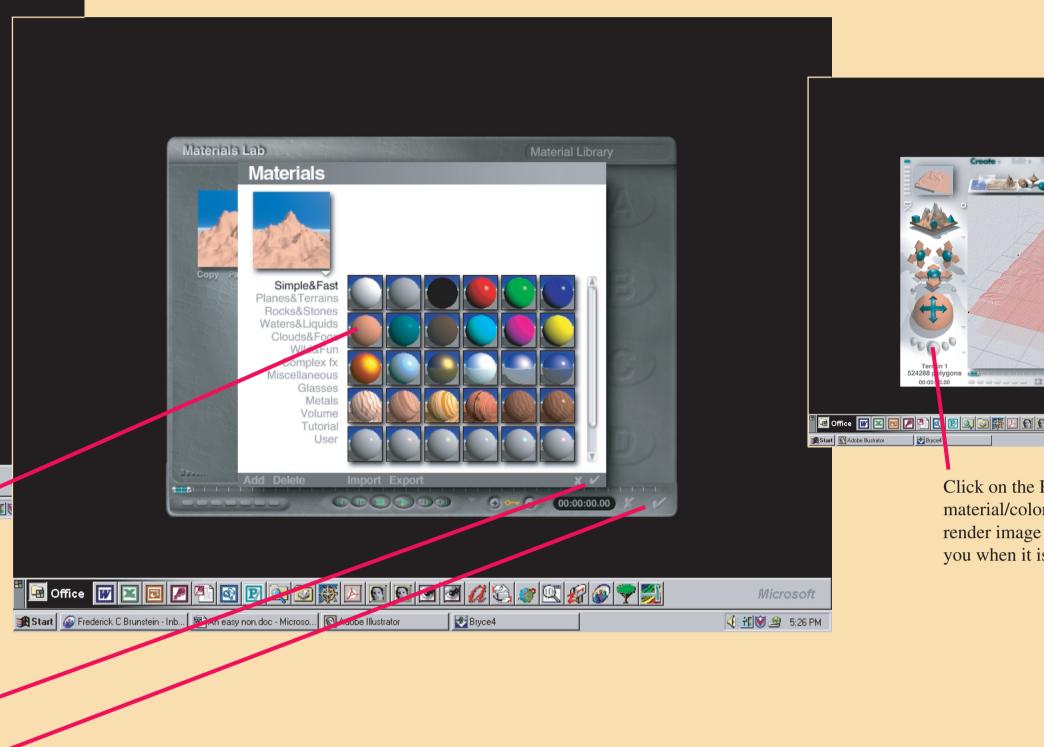


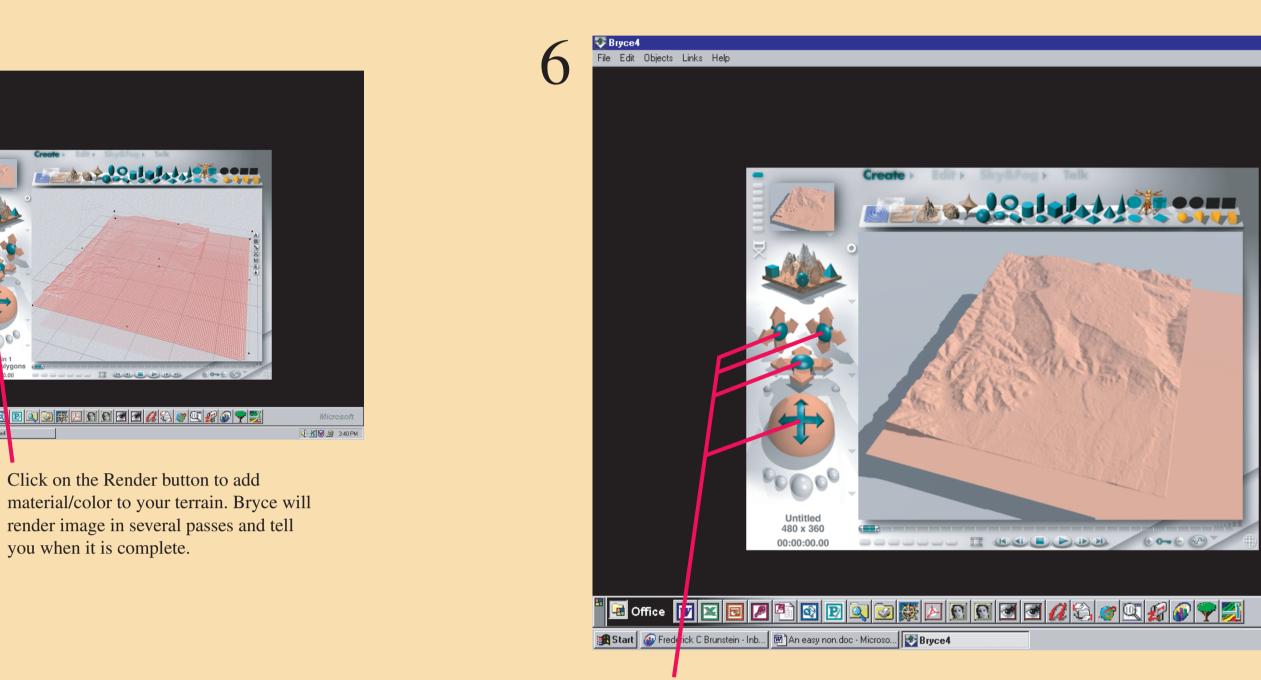


Click the check mark in the Materials Lab

window to confirm selection

Click on Materials Tab.

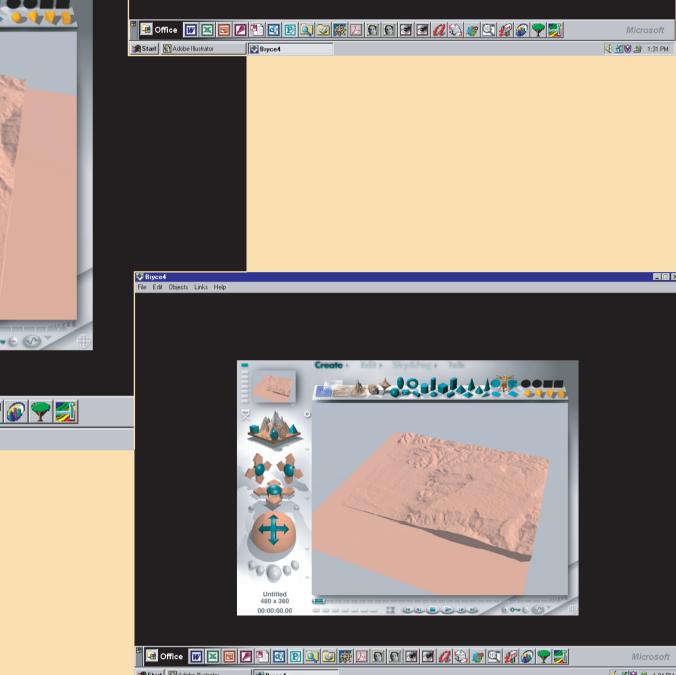


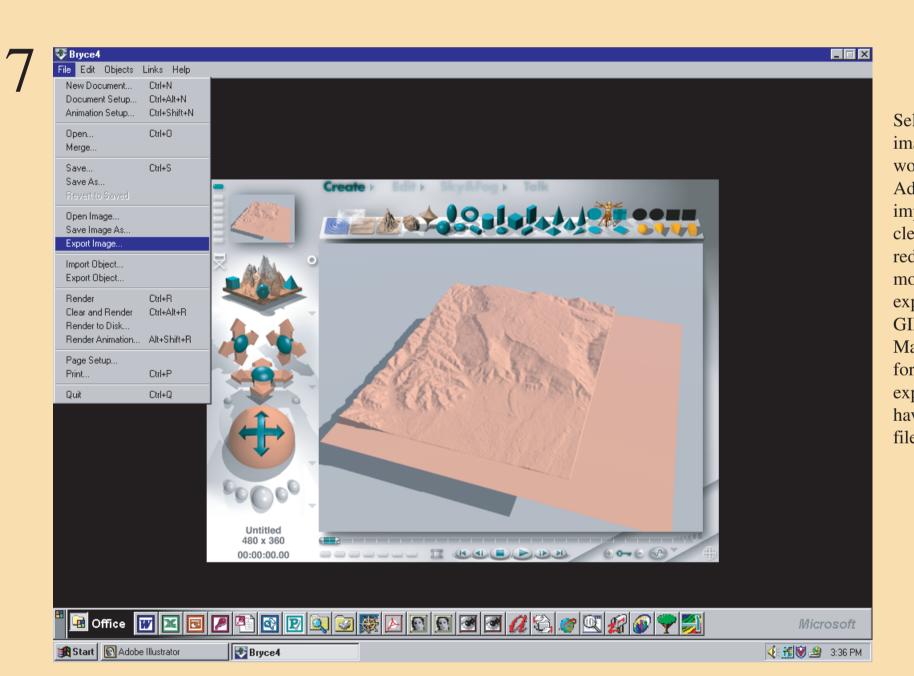


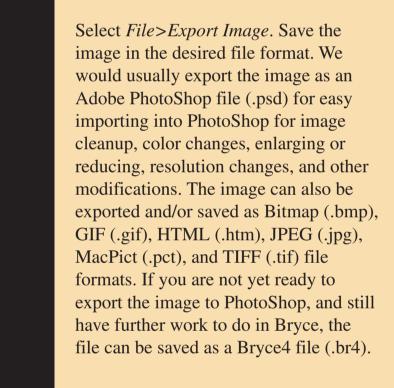
Rendered image in Bryce. Move and

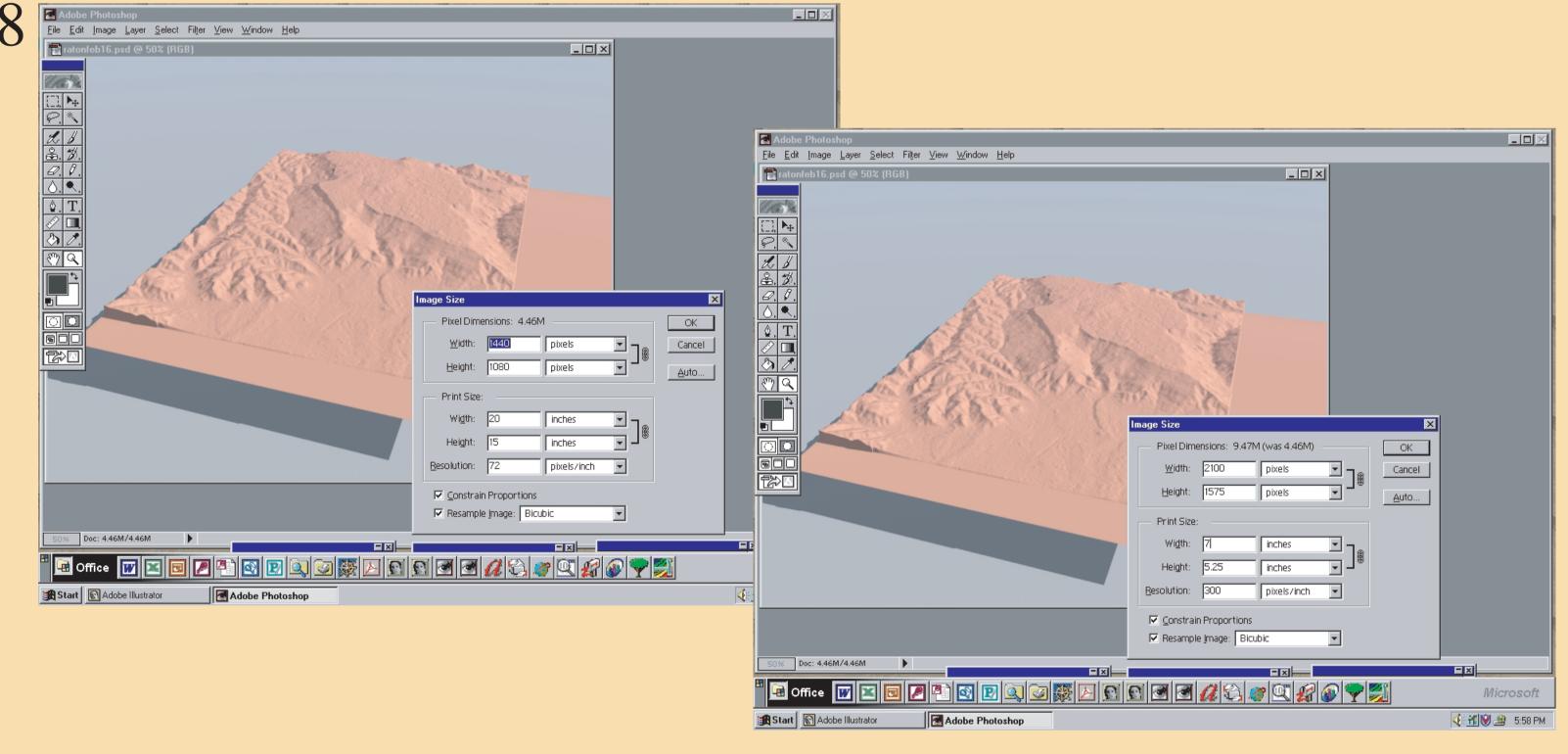
rotate image as desired using the

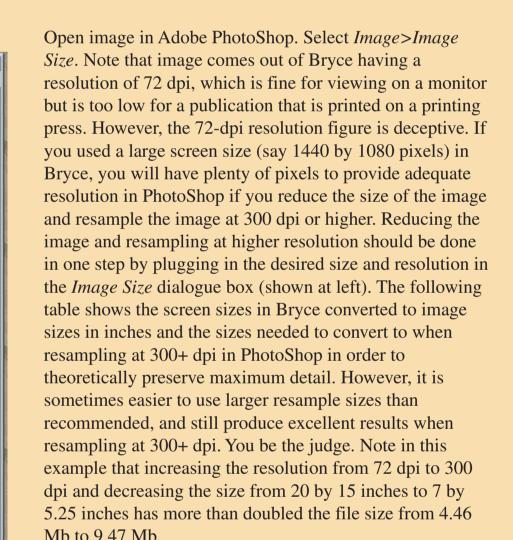
directional buttons.



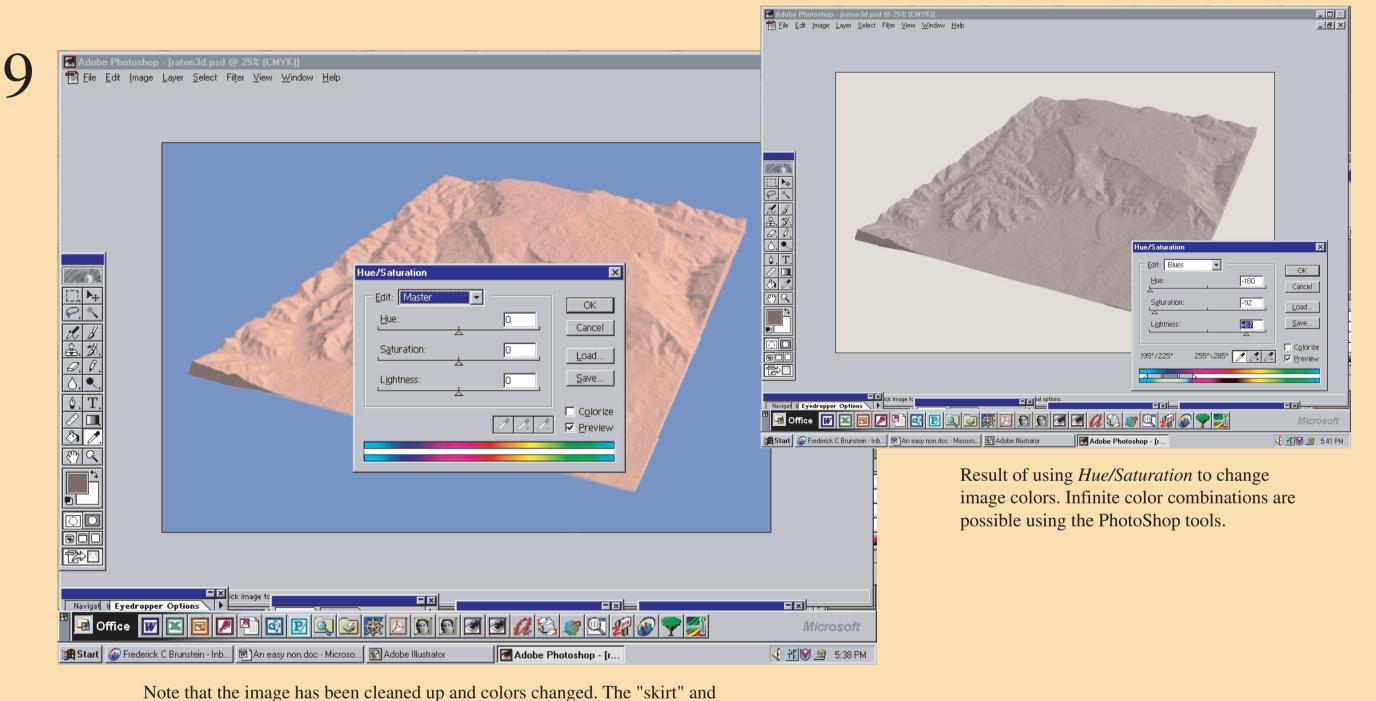


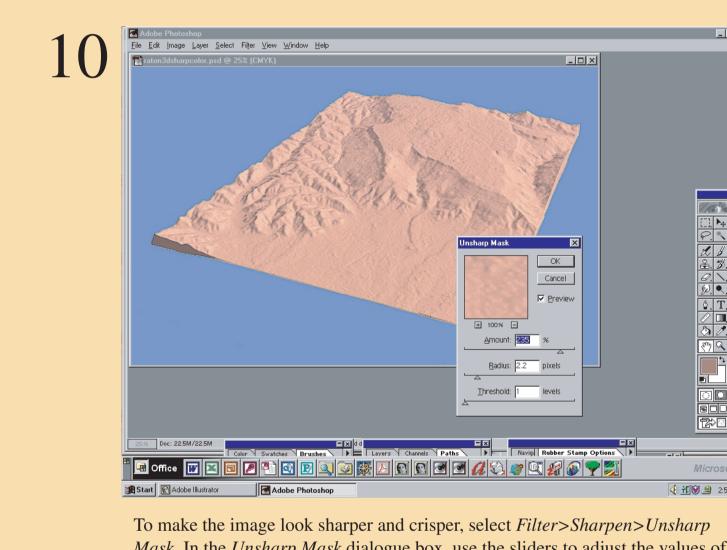




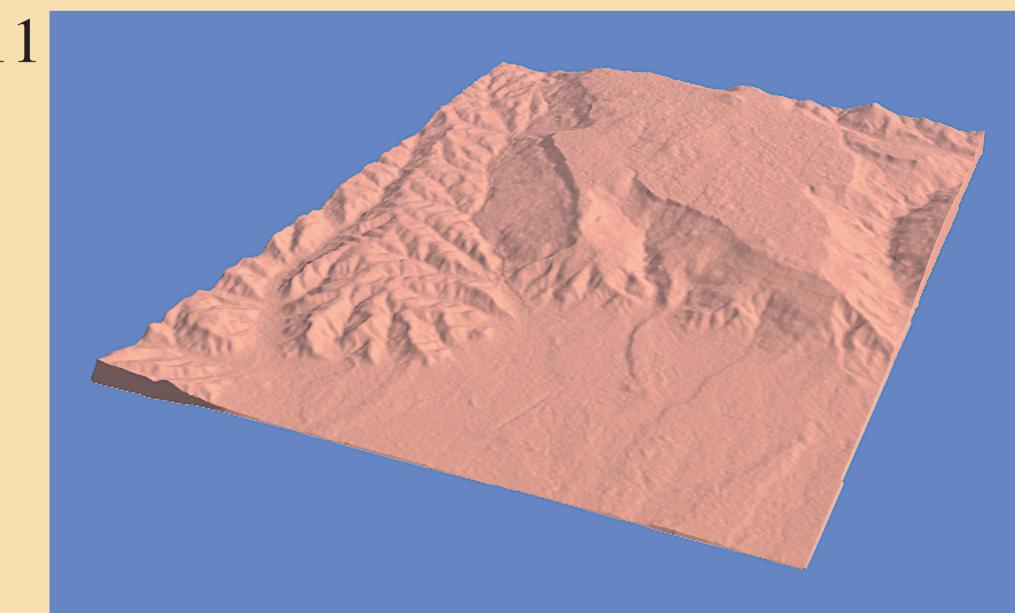


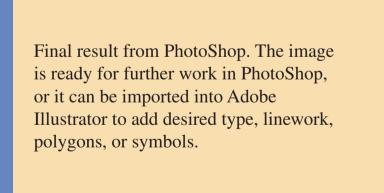
Resolution (Bryce) (pixels)	Size of image (inches)	Resample size at 300 dpi
(Pineis)	(menes)	(inches)
120 x 90	1.6 x 1.25	0.4×0.3
240 x180	3.3 x 2.5	0.8×0.6
480 x 360	6.6 x 5	1.6 x 1.2
720 x 540	10 x 7.5	2.3 x 1.8
960 x 720	13.3 x 10	3.2×2.3
1440 x 1080	20 x 15	4.8 x 3.6
1920 x 1440	26 x 20	6.2 x 4.8

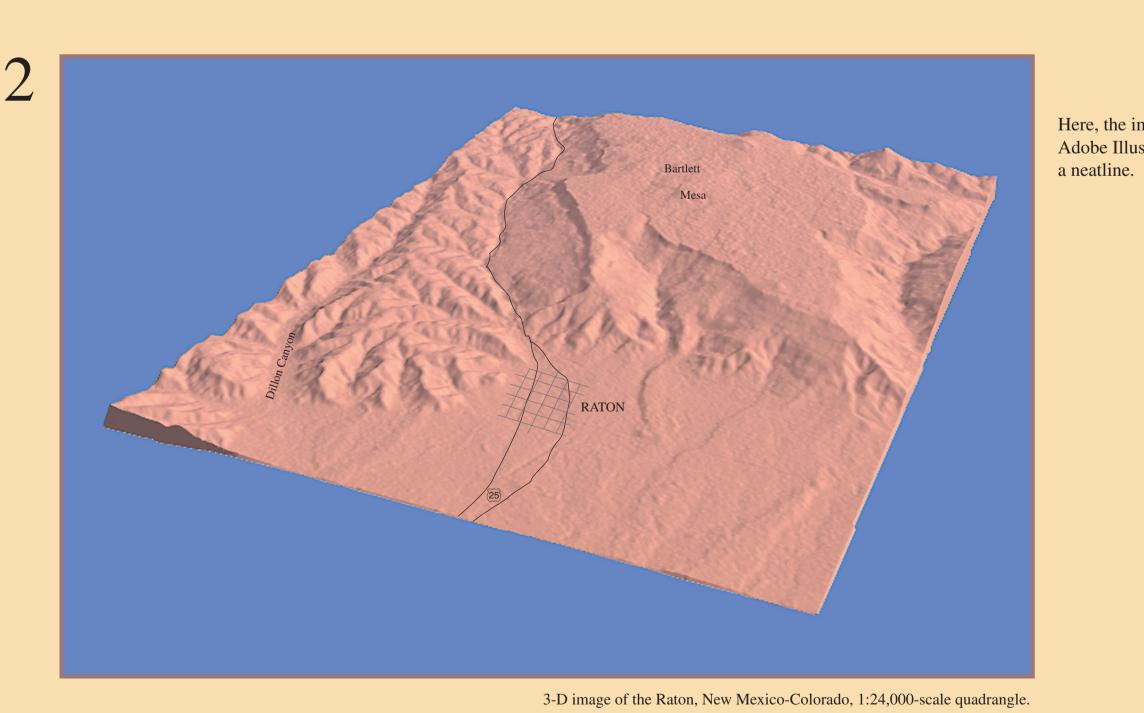




Mask. In the Unsharp Mask dialogue box, use the sliders to adjust the values of Amount, Radius, and Threshold. The values shown in this example worked well to sharpen the image. You may want to experiment with other values to obtain the results you want. [Note: *Unsharp Mask* can sometimes create "jaggies" along the edge of the image. If desired, a clean, straight crop of the jaggies can be made using the *Pen Tool* to draw a closed rectangle that includes part of the blue area and the straight edge of the terrain. Then select Window> Show Paths>Fill Subpath (click Foreground Color, which is blue in this example). The rectangle will be filled with blue and the jaggies will be cropped. Then delete the path. Alternatively, other PhotoShop tools can be used to clean up the jaggies, or use the pen tool in Illustrator to draw a line along the edge of the image to hide the jagged edge.]

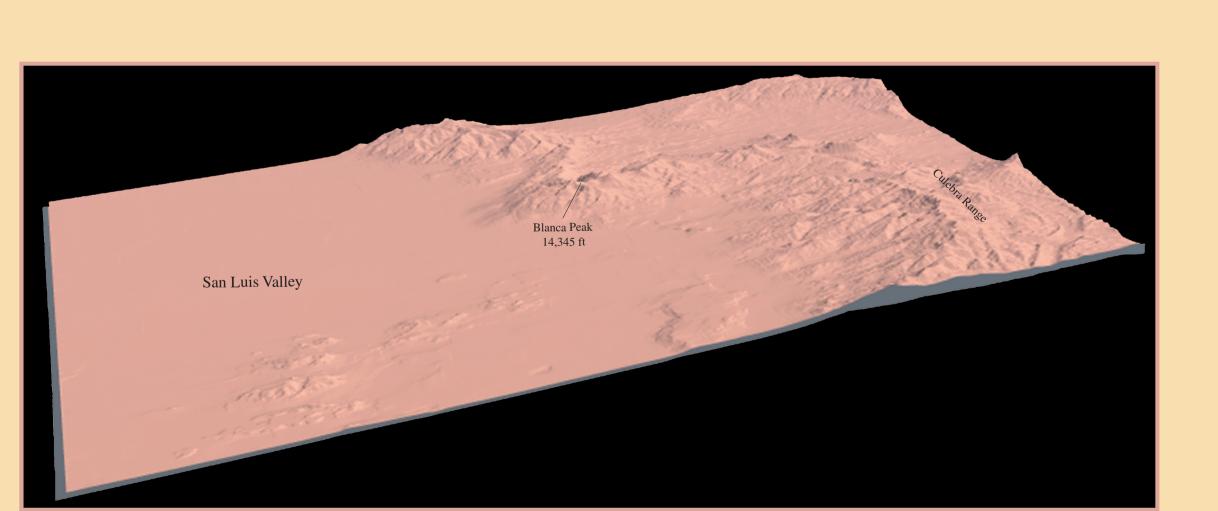




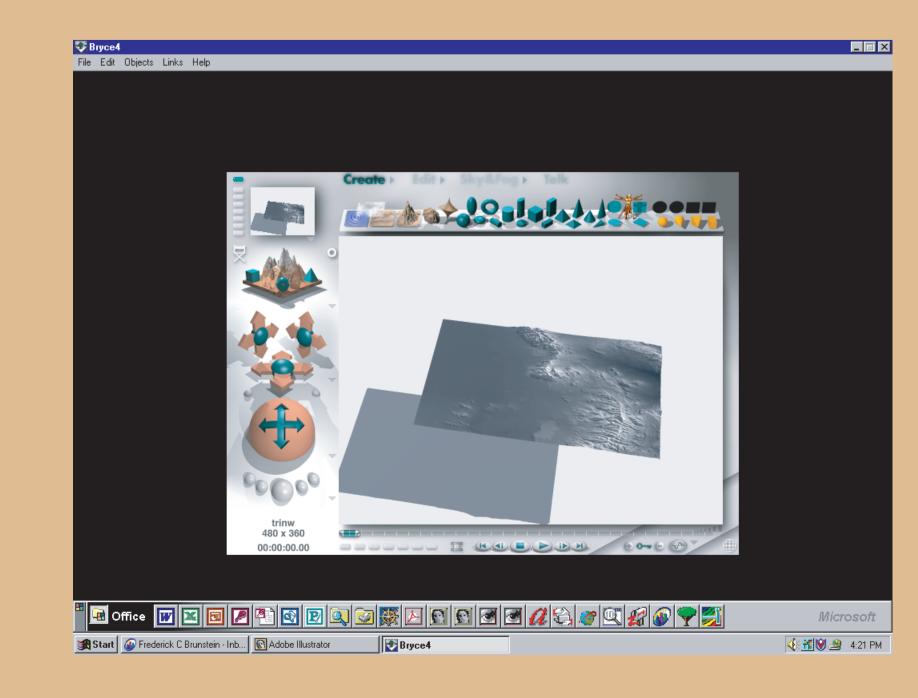


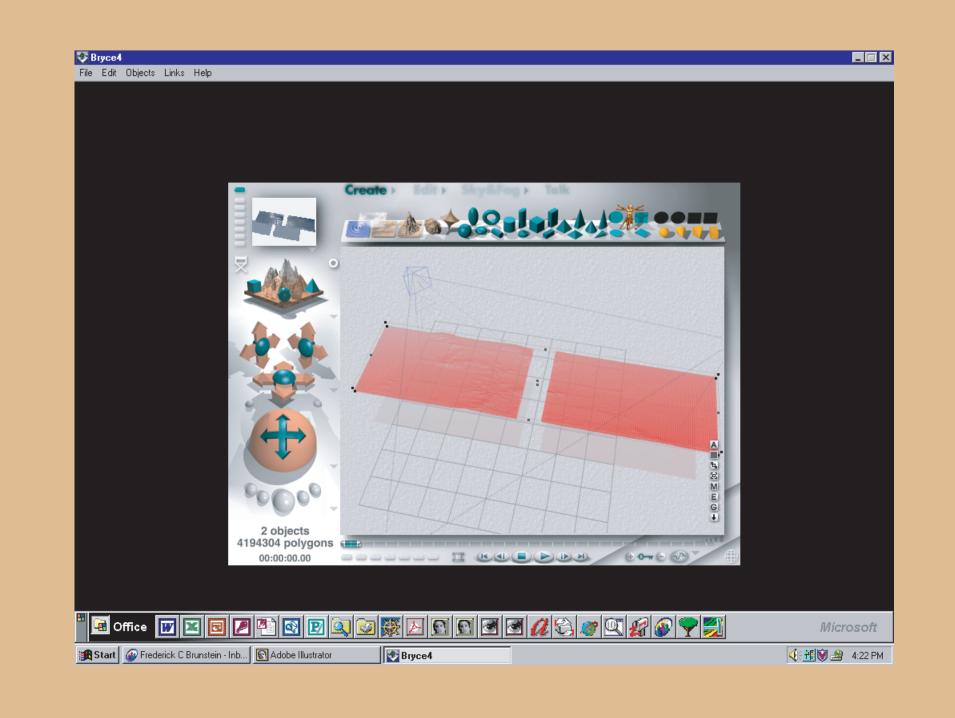
Here, the image has been imported into Adobe Illustrator to add lines, type, and

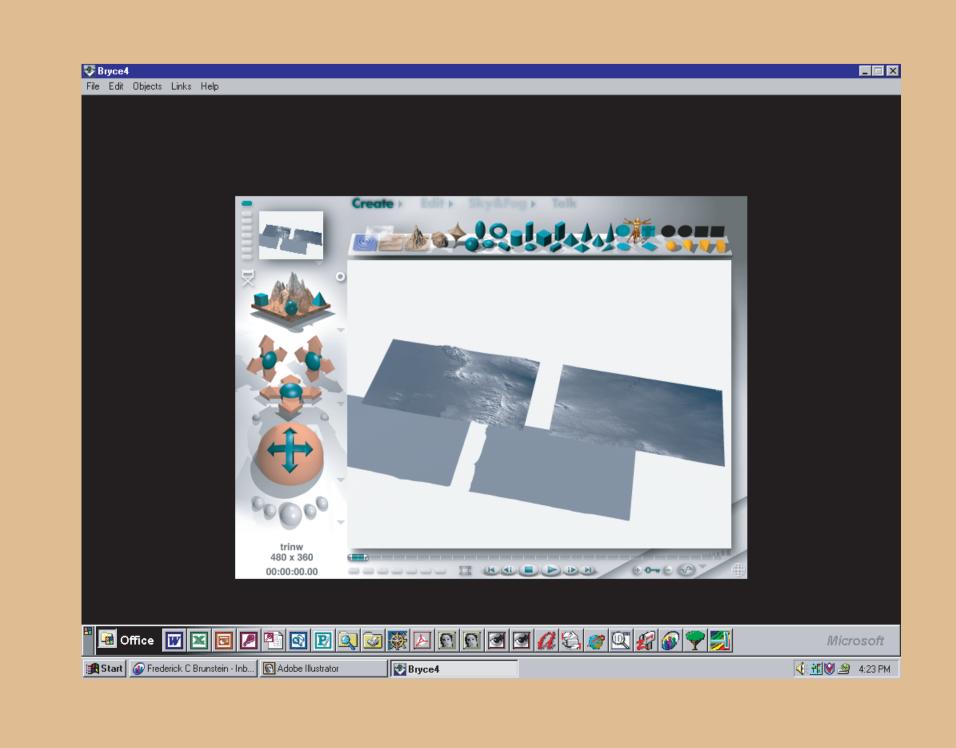


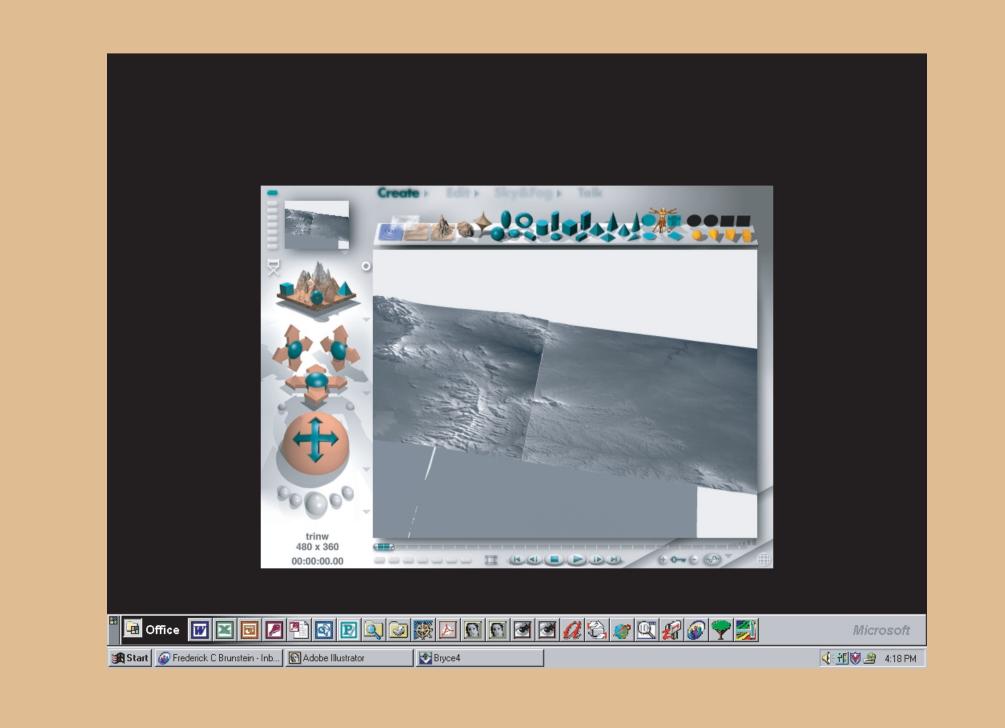


Two 3-D images of the west half of the Trinidad, Colorado, 1:250,000-scale quadrangle. The version on the left has had *Unsharp Mask* applied in order to sharpen the image. The version on the right did not have *Unsharp Mask* applied.









parts of the shadow underneath the DEM have been removed and other clean

up has been done. The Magic Wand, Lasso, Eye Dropper, Paint Bucket, Pen,

and other tools were used to select and change the colors of the "skirt" and

shadow to match the surrounding background color. Select *Image>Mode>*

Hue/Saturation to adjust and change the color of image as desired. To change

the background color without altering the terrain color, select the background

color using the magic wand tool and then fill it with the desired color with the

Eye Dropper and Paint Bucket tools.

Merging DEM's Example shown is the merging of the west and east halves of the Trinidad 1:250,000-scale quadrangle. First, in the *Document Setup* window, select the render resolution (see step 2 above). Then Select *File>Import* Object and navigate to the DEM of the west half of the quadrangle and open it. Then select File>Import Object and navigate to the DEM of the east half of the quadrangle and open it. Both DEM's are now in the same window. Use the cursor arrow and navigation arrows to select and move each of the DEM's for a best-fit merge. (It won't be perfect.) You will probably have to adjust the vertical exaggeration of one or both of the DEM's in order for the terrains to match up more closely. You'll also need to use the navigation arrows to look at all aspects of the merge because you are merging the DEM's in 3-D. Also note that certain colors work much better for merging DEM's. Some colors produce poor terrain matching. Dark brown is often a good color to use. (Pick dark brown in the Simple and fast list. Click on the Materials icon to see the *Simple and fast list*.) Select *File>Export Image* and export image as a .psd file. You can touch up the merge line and do other cleanup in PhotoShop, if desired.